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**DEEP GROUNDWATER  
TECHNICAL MEMORANDUM**

**H.O.D. LANDFILL  
ANTIOCH, ILLINOIS**

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**Prepared For:**

**Waste Management of Illinois, Inc.  
Westchester, Illinois**

**Prepared By**

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**April 1998**



**MONTGOMERY WATSON**

**Deep Groundwater  
Technical Memorandum  
H.O.D. Landfill**

**I. Issue Statement**

Detections of vinyl chloride have been reported in one off-site, deep groundwater aquifer monitoring well, US03D, near the H.O.D. Landfill Site. The concentrations of vinyl chloride in the off-site deep sand and gravel aquifer groundwater exceed the Federal Maximum Contaminant Level (MCL) and the State of Illinois groundwater protection standard. The source of the vinyl chloride is not definitively known; the detections may be attributable to the landfill, the adjoining industrial park, a more distant source, or the former Cunningham/Quaker Village Dump through which the deep aquifer monitoring well was installed.

**II. Background Information**

**Site Physical Characteristics**

The Site includes approximately 51 acres of landfilled area (Figure 1). Permitted waste disposal activities began at the Site in 1963 and continued through site closure in 1984. The H.O.D. Landfill Site was covered in accordance with 35 IAC 807 in 1989. The Site is bordered on the south and west by Sequoit Creek. A large industrial park area (Sequoit Acres Industrial Park), which was at least partially constructed on former fill areas, is located west of the Site and also borders Sequoit Creek. Sequoit Acres Industrial Park includes at least six companies designated as small quantity hazardous waste producers, five registered underground storage tanks ranging in size from 60 gallons to 200,000 gallons, and fill areas that were, at least in part, waste dumps (*e.g.*, Cunningham/Quaker Village Dump). These waste dump areas were apparently in existence prior to development of the H.O.D. landfill, and installation of monitoring well US03D and the Village of Antioch water supply well no. 4 (VW4) were apparently installed through these areas.

The Village of Antioch obtains its water from six water supply wells screened in the deep sand and gravel. The Village wells were installed between 1906 and 1997 and are located west and southwest of the Site. In July 1997, VW4 was taken out of service and replaced with VW7, located southwest of the industrial park. As presented in the RI, there are no known private drinking water wells west of the Site within the Sequoit Acres Industrial Park.

### **Hydrogeologic Setting**

In the site area, about 200 feet of unconsolidated deposits overlie the Silurian dolomite (Racine Formation) bedrock. The stratigraphy beneath the Site, to a depth of approximately 110 feet, is illustrated in the cross-section shown on Figure 2. Based on site data and supplemental regional information, the following four hydrogeologic units, from the surface downward, are recognized in the unconsolidated sequence:

1. **Surficial Sand** – The surficial sand unit is present only in the southern portion of the Site and generally consists of light brown to gray, fine to coarse grained sand, with varying amounts of gravel, silt, and clay. The maximum reported thickness of this unit is 54 feet. Groundwater in the surficial sand is shallow and flows into Sequoit Creek under a shallow hydraulic gradient.
2. **Clay-Rich Diamict Till Aquitard** – Based on soil borings drilled in the vicinity of the Site, the surficial sand is underlain by a clay-rich diamict till, which is typically light to dark gray massive silty to lean clay and is present beneath the entire Site. The clay-rich diamict acts as an aquitard, separating the surficial sand from the underlying deep sand and gravel. Groundwater gradients within the clay-rich diamict are primarily downward. During the RI, laboratory constant head permeability testing results indicated that the vertical and horizontal hydraulic conductivities of this clay-rich diamict are low; as a result, poor hydraulic communication exists between the surficial sand and the deep sand and gravel. The approximate 30 foot head differential (see contours on Figure 2) that is maintained across this unit reflects its low permeability. The properties of this soil layer were the basis for IEPA's approval of the H.O.D. site as a suitable location for a solid waste landfill.
3. **Deep Sand and Gravel** – The deep sand and gravel is present beneath the entire Site. This unit is a confined aquifer that provides water for the Village of Antioch, and to private wells at residences located east (hydraulically upgradient) of the Site. The deep sand and gravel may be up to 185 feet thick in the general vicinity of the Site. Logs for the nearby public water supply wells of the Village of Antioch suggest that it is probably about 60 feet thick at the Site.
4. **Till (Tiskilwa Till Members)** - Regional information indicates that a reddish gray silty clay till underlies the deep sand and gravel. This unit was not encountered in site borings, but the log for a supply well for the Village of Antioch indicates that this unit is approximately 60 feet thick.

### III. Contaminant Fate and Transport

#### Historical Data

Historic data for volatile organic compound detections in area monitoring wells, leachate wells and two Village of Antioch supply wells, VW3 and VW4, are summarized on Figure 1. The acetone and methylene chloride detections in the monitoring wells appear to be laboratory artifacts due to the detections of these compounds in many of the associated laboratory blanks ("B" Qualifier). Vinyl chloride and/or 1,2-dichloroethene (1,2-DCE) have been detected in groundwater samples from only one deep sand and gravel monitoring well, US03D, located in the industrial park (at maximum concentrations of 35 µg/L and 74 µg/L, respectively), and water supply wells VW3 and VW4. The MCL for vinyl chloride is 2 µg/L, and the MCL for cis-1,2-DCE is 70 µg/L. Vinyl chloride concentrations at US03D appear to be relatively constant with time (Figure 1).

The VOC concentrations at the municipal wells appear to be stable or declining. For example, vinyl chloride in VW4 was last detected on August 23, 1989, at 0.2 µg/L, and has not been detected in 24 samples subsequently collected from this well. VW4 was taken out of service in July 1997 and will be properly abandoned. 1,2-DCE was detected in VW3 in one sample collected in 1994. The detection was a very low estimated concentration of 0.7µg/L that could have been a laboratory artifact. Regardless, if the detection was due to contamination, it is unlikely that the source was to the east because VW4 was in operation and would have intercepted flow from that direction. Also, the dominant contaminant in the deep sand and gravel aquifer to the east near the Site is vinyl chloride. Since this compound is more mobile than 1,2-DCE, some vinyl chloride would be expected at MW3 if the source were to the east.

Vinyl chloride was detected at the Site at low levels in the shallow aquifer (W5S at 19 µg/L, G102 at 2.4 µg/L) and leachate (MHE at 18 µg/L). Vinyl chloride was not detected in any of the on-site deep sand and gravel wells. Notably, vinyl chloride was not detected in US04D, which is in the southwest corner of the "old landfill," very near shallow well W5S, where this compound was identified. Vinyl chloride was not detected in off-site deep sand and gravel wells US02D or W3D, and has not been measured in VW4 since 1989. These data indicate that the areal extent of the vinyl chloride impact in the deep sand and gravel aquifer (around US03D) is limited.

#### Source of Vinyl Chloride

The general vicinity around wells VW4 and US03D (both wells are screened within the deep sand and gravel aquifer) was studied during the RI, but the results of the investigation are not conclusive. Several nearby potential sources, including the landfill, have been identified. The available on-site data do not show concentrations of vinyl chloride, or possible precursor compounds, in leachate or site groundwater that

would account for concentrations of up to 35 µg/L of vinyl chloride detected off-site in US03D. For example, the highest concentration of vinyl chloride reported in a shallow on-site monitoring well was 19 µg/L (W5S), and the highest level detected in a leachate well was 18 µg/L (MHE). Concentrations of typical potential vinyl chloride precursor compounds such as 1,1-DCE 1,2-DCE, trichloroethene (TCE) and tetrachloroethene (PCE) also appear too low (the highest individual compound concentration detected was 190 µg/L of 1,2-DCE in leachate well LP11) to account for the US03D vinyl chloride concentration in the deep sand and gravel aquifer, considering that attenuation would occur during migration of the surficial sand aquifer groundwater to the deep sand and gravel aquifer.

Other potential nearby sources have been identified, off site, to the west of the landfill. Both VW4 and US03D were apparently constructed through refuse material in the former Cunningham/Quaker Village Dump and both wells are located in the Sequoit Acres Industrial Park that includes several small quantity hazardous waste generators. Therefore, the former Cunningham/Quaker Village Dump or the industrial park may be associated with the vinyl chloride found in US03D and VW4. For all these nearby sources, including the landfill, the potential to affect the deep sand and gravel aquifer is diminished by the presence of the confining clay-rich till aquitard.

Identification of a source, or sources, for these vinyl chloride concentrations is further complicated because groundwater flow rates in the permeable deep sand and gravel aquifer may be relatively high, especially near the high capacity municipal water supply wells, and the groundwater flow patterns in the site area have probably changed significantly since the late 1940s when the use of solvents, that could be the source of these vinyl chloride concentrations, was becoming widespread. As a result, sources that are more distant than those identified above are possible.

Regionally, the deep sand and gravel aquifer is recharged in the vicinity of the Fox River, four to five miles west of the Site, and the original natural groundwater flow was probably to the east (RI, 1997). This pattern has been altered by pumpage for water supply from the municipal wells. Prior to 1953, the Village of Antioch obtained its water supply from two wells, VW1 and VW2, located about 3,000 feet west/northwest of the Site. In 1953, VW3 (about 1,000 feet west of the site) was added to the system and, in 1965, VW4 was placed into service about 280 feet west of the Site. The proximity of, and higher production from, these additional wells is likely to have modified the flow pattern in the deep sand and gravel aquifer at the Site significantly. The installation and operation of VW5 in 1978 (about 1,700 feet southwest of the Site) may have caused additional changes in the groundwater flow pattern.

The magnitude of these potential groundwater flow pattern changes in the vicinity of the Site in response to the expansion and modification of the village well system is indicated by water level monitoring data collected during the RI and after the termination of the pumping of VW4. In 1993 and 1994, when VW4 was in operation, the gradient in the deep sand and gravel aquifer was generally southwest and west converging toward VW4. However, following termination of pumping of VW4 on June

16, 1997, the gradient changed, and by July 30, 1997 was to the south (H.O.D. Landfill Monitoring Well Gauging Report, 1997) .

Since the groundwater flow pattern in the vicinity of the Site area has apparently changed over time in response to pumping of the Village of Antioch wells, the source of the vinyl chloride concentrations in the groundwater cannot be clearly identified on the basis of the current distribution of vinyl chloride. Furthermore, since the operation of these high capacity supply wells accelerates the groundwater flow rate, it is possible that the source is distant, perhaps from an area where the till aquitard is locally thin or absent. A relatively long pathway and/or an old source is also suggested by the predominance of vinyl chloride and 1,2-DCE, which are late members of the typical degradation sequence for the most common chlorinated solvents.

### **Risk Evaluation**

Although the source of the vinyl chloride and 1,2-DCE off site at US03D is not certain, the existing concentrations of these compounds in the deep sand and gravel aquifer may represent a risk for potential groundwater receptors. The excess cancer risk associated with consumption of groundwater from US03D was estimated in the Baseline Risk Assessment to be  $9 \times 10^{-4}$ . However, consumption of groundwater from a well at US03D does not appear to be a reasonable scenario for evaluating potential risks. The Village of Antioch water supply wells represent the nearest points of human exposure, because the Village has an ordinance effectively prohibiting the installation of private water supply wells in the industrial park area (Antioch Water Works and Sewage Ordinance: Sections 50.008, 52.009 and 52.011). Therefore, the potential risk for VW3, about 825 feet west of US03D, was estimated by conducting TACO modeling based on RBCA equation R26. Equation R26 is used to predict contaminant concentrations along the centerline of a plume emanating from a vertical, planar source of specified height and width. The source is assumed to discharge groundwater with a constant contaminant concentration. This equation accounts for both three-dimensional dispersion and biodegradation of the contaminant during transport from the source. Equation R26 may be used to predict contaminant concentrations at locations downgradient from the source or, conversely, predict source concentrations that would be necessary to account for observed concentrations at downgradient locations.

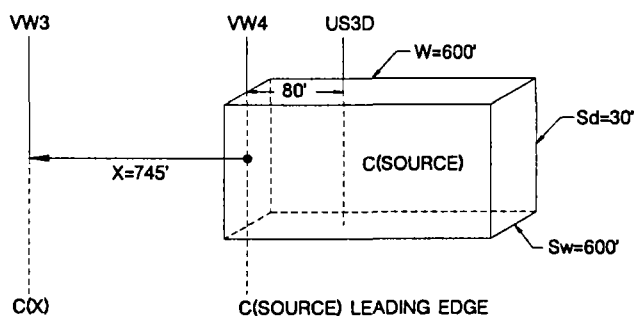
The modeling using equation R26 incorporated site-specific parameters that were selected to promote conservative results. That is, the model results should significantly overestimate contaminant transport distances from the source and concentrations at potential receptor locations.

The model framework was developed on the assumption that a continuing source of contamination is present in the vicinity of US03D. The horizontal dimensions of the hypothetical source enclave, which is illustrated on Figure 1, were assumed to be 600 feet by 600 feet. This area represents a very conservative estimate of the source dimensions because it includes two deep sand and gravel aquifer wells, US04D and W3D, that do not indicate the presence of either vinyl chloride or 1,2-DCE. The

thickness of the source enclave was assumed to be 30. Again, US04D does not indicate the presence of vinyl chloride or 1,2-DCE.

In the model, it was assumed that the hydraulic gradient in the deep sand and gravel aquifer is west from the enclave, directly toward VW3. This assumption is, again, conservative because the present gradient, following the shutdown of VW4, appears to be more southerly. The gradient was estimated as 0.0006 based on the recent potentiometric data obtained after the termination of pumping at VW4 (H.O.D. Landfill Monitoring Well Gauging Report, 1997). A hydraulic conductivity value of  $5 \times 10^{-2}$  cm/s was assumed for the deep sand and gravel aquifer. This value was calculated from the results of the USGS pumping test (RI) with an assumed aquifer thickness of 150 feet. To promote additional conservatism in the modeling lower values based on single well tests were not used to promote additional conservatism in the modeling.

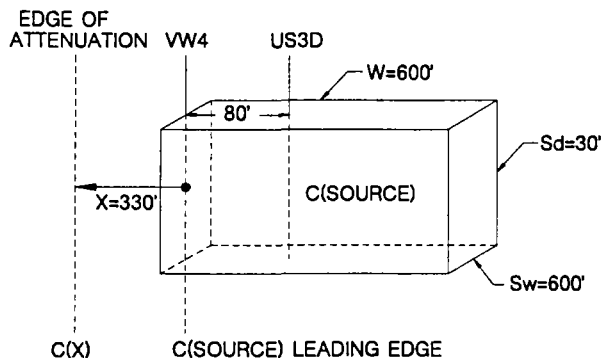
Two model scenarios, designated A and B, were evaluated. Scenario A is illustrated in the following figure. Scenario A was developed to predict the concentrations necessary within a source plume that would result in an exceedance of MCLs at VW3.



The theoretical source enclave proposed for Scenario A has a width perpendicular to groundwater flow of 600 ft ( $S_w$ ), a length parallel to groundwater flow of 600 ft ( $W$ ) and a depth of 30 ft ( $S_d$ ).

Site specific and default parameters for Scenario A are presented in Tables 1 and 2. A TACO default half life of  $0.00024 \text{ d}^{-1}$  was used for vinyl chloride and 1,2-DCE. This scenario was developed to predict hypothetical source concentrations of vinyl chloride and 1,2-DCE that would result in MCL concentrations of 2 and 70  $\mu\text{g/L}$ , respectively, at VW3. The R26 equation predicted hypothetical source concentrations of 730  $\mu\text{g/L}$  for vinyl chloride and 25,500  $\mu\text{g/L}$  for 1,2-DCE (Table 3). These concentrations are specifically (one to two orders of magnitude) greater than actual concentrations measured at US03D, and much higher than any concentrations measured anywhere on the Site. These results indicate that the existing concentrations at US03D do not represent a current or future risk to VW3. The relatively smaller predicted hypothetical concentration for vinyl chloride indicates that this compound is of more potential concern than 1,2-DCE.

Scenario B, which is illustrated in the following figure, was conducted to specifically evaluate vinyl chloride transport.



Site specific and default parameters for Scenario B are presented in Tables 4 and 5. A default half life of  $0.00024 \text{ d}^{-1}$  was again used for vinyl chloride and 1,2-DCE. In this scenario, the R26 equation was utilized to predict the distance from the leading edge of the theoretical source enclave to the point where the MCL concentration of  $2 \mu\text{g/L}$  for vinyl chloride would be achieved (Table 6). The resulting distance of 330 feet (10058.4 cm) (Table 5) is within the Sequoit Acres Industrial Park, outside the required 400-foot setback radius for VW3, and far short of VW3 itself. This theoretical attenuation distance appears to be much greater than current field data suggest for westward vinyl chloride transport. The current absence of detectable vinyl chloride at VW4 indicates that westward migration of vinyl chloride from US03D is less than 80 feet. The much greater distance predicted by the model reflects the conservative assumptions that it incorporates. At the calculated distance where the vinyl chloride concentration has been reduced to the MCL, the predicted concentration of 1,2-DCE is well below the MCL, as expected based on the results for Scenario A.

In summary, these conservative modeling results indicate that while vinyl chloride is a compound of concern, current concentrations at US03D do not represent a current or future potential risk for the nearest potable water supply well (VW3), and that concentrations at US03D would have to rise by more than an order of magnitude to potentially produce an MCL concentration ( $2 \mu\text{g/L}$ ) at VW3.

#### IV. Potential Response Actions

The source of the vinyl chloride in the off-site wells is uncertain and the current distribution may not reflect the source(s) because the historic pattern of migration has been affected by pumping. Moreover, it is unlikely that the source(s) will ever be confirmed. In this circumstance, the appropriate response action should focus on addressing risks that the identified contamination poses.



Concentrations of vinyl chloride do not appear to be increasing over time in the deep sand and gravel aquifer at off-site deep sand and gravel monitoring well US03D near the southwest corner of the Site, and do not represent a current or future risk to potential groundwater receptors. The conservative model calculations presented above indicate that the observed VOC contamination at US03D will not reach VW3, even if a consistent gradient to the west were reestablished. Furthermore, in order for vinyl chloride to become a potential risk, concentrations at US03D would have to increase at least an order of magnitude. The current absence of vinyl chloride at VW4 emphasizes the conservatism in the model predictions.

Potential contaminant contributions from the Site are not subject to wide variations over a short period of time. This has been demonstrated by historic analytical results for the on-site monitoring wells (Figure 1). Thus, if the vinyl chloride at US03D is, in fact, attributable to the Site, long-term monitoring at US03D would give adequate warning of a potential change in conditions that could potentially impact VW3.

Groundwater monitoring with scheduled periodic review of results is ongoing, and will be expected to be a component of the final remedy for the H.O.D. Site. This program will identify changes in the distribution and levels of vinyl chloride that might occur. If future monitoring results indicate increases in concentrations that are due to the landfill and may pose a risk to the village wells, remedial measures to address groundwater in the deep sand and gravel aquifer may be evaluated, designed and implemented. Again, the monitoring at US03D will provide an ample margin of safety to address the contamination and implement remedial measures prior to affecting VW3.

Active remedial response measures, such as groundwater extraction and treatment (sparging is not an alternative because the aquifer is confined) to address the current vinyl chloride concentrations at US03D would likely be technically impracticable. The effectiveness of an extraction system designed to capture the impacted part of the aquifer could be compromised in the future because groundwater flow patterns in the area are likely to continue to change as development occurs. In addition, high rates of pumping would be necessary from the transmissive aquifer to achieve capture. The need for high pumping rates is supported by the fact that extraction of groundwater from VW4 (with a capacity of 650 gpm) over many years did not result in significant reductions in vinyl chloride concentrations at US03D.

The large volume of extracted water would present a discharge problem. Sequoit Creek has limited capacity, particularly during wet periods. Therefore, another surface water discharge point would be required. There are no suitable discharge points in the general area, resulting in insurmountable implementability issues if one were to consider the feasibility of constructing a long distance discharge system. For purposes of cost estimates in the FS, the nearest surface discharge point was assumed to be 2 miles from the Site. Construction of a discharge pipeline to this point for deep groundwater conveyance would be prohibitively expensive, and due to the many road crossings and easements required, would likely be technically impracticable. Moreover, injection would also probably not be a practical alternative due to the high

maintenance associated with injection wells and the potential for changes in the area groundwater flow pattern. If the area groundwater flow pattern changed, the injection system could promote migration of contaminants into unaffected parts of the aquifer and, possibly, toward the village supply wells.

Landfill source control measures, including restoring/repairing the cap, upgrading and operating the leachate collection system, and the collection and treatment of landfill gas are expected to be components of the final remedy for the H.O.D. Site. These source control measures will act to reduce the amount of contaminants that may potentially enter groundwater. The landfill gas control measures will be particularly effective in removing VOCs such as vinyl chloride. If the landfill is a source of the vinyl chloride identified at US03D, these measures should, over time, reduce the release of this contaminant or its parent products and the concentration at US03D should decrease in the future.

## **V. Summary**

Analysis of the available information described in the preceding sections indicates the following conclusions:

- The source of vinyl chloride in the deep sand and gravel aquifer is uncertain and is unlikely to be identified. Potential nearby sources include the H.O.D. landfill, the adjoining industrial park or former waste dump areas off site to the west.
- The limited distribution and existing concentrations of vinyl chloride in the deep sand and gravel aquifer do not represent a current or future risk to VW3, the nearest point of human exposure.
- A suitable long-term monitoring program, particularly at US03D, should give adequate warning of a potential change in conditions that could impact VW3.
- Implementation of source control measures that include capping, leachate control and landfill gas control will reduce the amount of contaminants that may potentially enter groundwater from the H.O.D. landfill.

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**TABLE 1**  
**Site Specific Parameters**  
**Scenario A**

| Input Parameters for Tier II Analyses                        |  |          |        |                |         |  |
|--|--|----------|--------|----------------|---------|--|
| Parameter  |  | Units    | Symbol | Range Name     | Value   | Comments   |
|  |  |          |        |                |         |  |
| PARAMETERS COMMON TO SSL AND RBCA EQUATIONS                  |  |          |        |                |         |  |
| Hydraulic gradient   |  | unitless |        | i              | 0.0006  | Site-specific  |
| Aquifer hydraulic conductivity                               |  | m/yr     |        | K              | 1576    | Site-specific (1 cm/sec=3.154e5 m/yr)  |
| Total soil porosity  |  | unitless |        | n <sub>1</sub> | 0.32    | Either 0.43 or gravel=0.25 or sand=0.32 or silt=0.40 or clay=0.36 or site specific from Eq. S24 or R23 |
| RBCA PARAMETERS  |  |          |        |                |         |  |
| Source width - vertical, perpendicular to groundwater flow   |  | cm       |        | Sd             | 914.4   | Either 200 or site specific. Must be site-specific for groundwater cleanup objective                   |
| Source width - horizontal, perpendicular to groundwater flow |  | cm       |        | Sw             | 18288   | Site specific  |
| Source width - parallel to wind or groundwater               |  | cm       |        | W              | 18288   | Site specific  |
| Distance along centerline of groundwater plume               |  | cm       |        | X              | 22707.6 | Site specific  |

**TABLE 2**  
**Default Parameters**  
**Scenario A**

| RBCA DEFAULT VALUES |       |       |    |   |         |         |
|---------------------|-------|-------|----|---|---------|---------|
| Symbol*             | Units | Value |    |   |         | Remarks |
|                     |       | R     | IC | C | Default |         |
| ax                  | cm    |       |    |   | 2270.76 | Eq. R16 |
| ay                  | cm    |       |    |   | 756.92  | Eq. R17 |
| az                  | cm    |       |    |   | 113.538 | Eq. R18 |
| U                   | cm/d  |       |    |   | 0.8093  | Eq. R19 |

NOTES:     R     Residential  
               IC     Industrial/Commercial  
               C     Construction Worker  
                Not applicable

\*  
 ax     Longitudinal Dispersivity  
 ay     Transverse Dispersivity  
 az     Vertical Dispersivity  
 U     Specific Discharge

**TABLE 3**  
**Results of Attenuation Model**  
**Scenario A**

**RBCA Equations:**


| CAS No.  | Chemical             | C <sub>source</sub><br>(mg/L) | R26<br>C(x)<br>(mg/L) | IEPA GWcomp (mg/L)          |                 |
|----------|----------------------|-------------------------------|-----------------------|-----------------------------|-----------------|
|          |                      |                               |                       | Obtained from SSL Worksheet |                 |
|          |                      |                               |                       | Tier 1 Class I              | Tier 1 Class II |
| 156-59-2 | 1,2-Dichloroethylene | 25.5                          | 0.0700032             | 0.07                        | 0.2             |
| 75-01-4  | Vinyl chloride       | 0.73                          | 0.0020040             | 0.002                       | 0.01            |

**TABLE 4**  
**Site Specific Parameters**  
**Scenario B**

| Input Parameters for Tier II Analyses                        |  |          |        |                |         |  |
|--|--|----------|--------|----------------|---------|--|
| Parameter  |  | Units    | Symbol | Range Name     | Value   | Comments   |
|  |  |          |        |                |         |  |
| PARAMETERS COMMON TO SSL AND RBCA EQUATIONS                  |  |          |        |                |         |  |
| Hydraulic gradient   |  | unitless |        | i              | 0.0006  | Site-specific  |
| Aquifer hydraulic conductivity                               |  | m/yr     |        | K              | 1576    | Site-specific (1 cm/sec=3.154e5 m/yr)  |
| Total soil porosity  |  | unitless |        | n <sub>1</sub> | 0.32    | Either 0.43 or gravel=0.25 or sand=0.32 or silt=0.40 or clay=0.36 or site specific from Eq. S24 or R23 |
| RBCA PARAMETERS  |  |          |        |                |         |  |
| Source width - vertical, perpendicular to groundwater flow   |  | cm       |        | Sd             | 914.4   | Either 200 or site specific. Must be site-specific for groundwater cleanup objective                   |
| Source width - horizontal, perpendicular to groundwater flow |  | cm       |        | Sw             | 18288   | Site specific  |
| Source width - parallel to wind or groundwater               |  | cm       |        | W              | 18288   | Site specific  |
| Distance along centerline of groundwater plume               |  | cm       |        | X              | 10058.4 | Site specific  |

**TABLE 5**  
**Default Parameters**  
**Scenario B**

| RBCA DEFAULT VALUES |       |       |    |   |         |         |
|---------------------|-------|-------|----|---|---------|---------|
| Symbol              | Units | Value |    |   |         | Remarks |
|                     |       | R     | IC | C | Default |         |
| ax                  | cm    |       |    |   | 1005.84 | Eq. R16 |
| ay                  | cm    |       |    |   | 335.28  | Eq. R17 |
| az                  | cm    |       |    |   | 50.292  | Eq. R18 |
| U                   | cm/d  |       |    |   | 0.8093  | Eq. R19 |

NOTES:     R     Residential  
               IC     Industrial/Commercial  
               C     Construction Worker  
                Not applicable

\*  
 ax     Longitudinal Dispersivity  
 ay     Transverse Dispersivity  
 az     Vertical Dispersivity  
 U     Specific Discharge

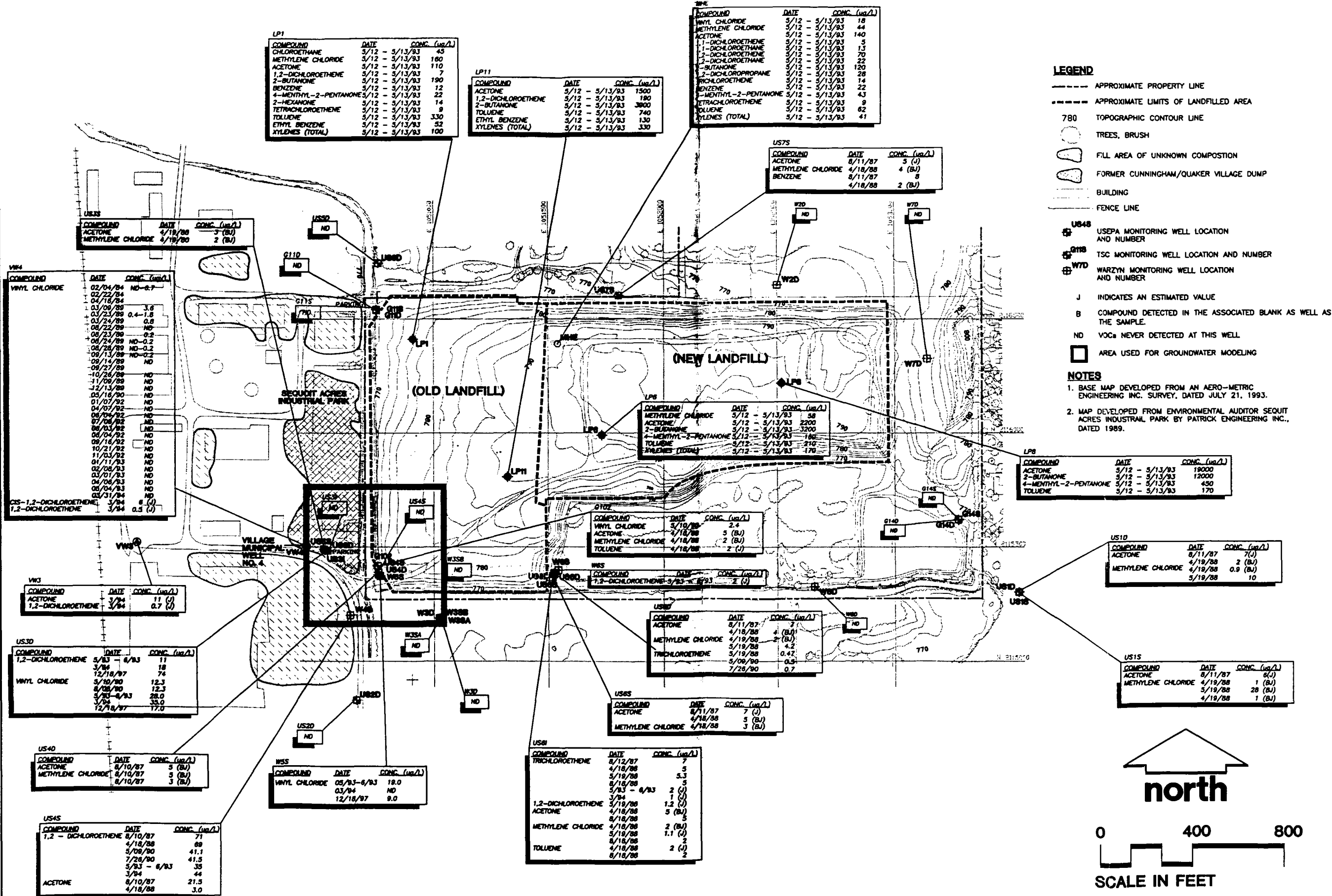


**TABLE 6**  
**Results of Attenuation Model**  
**Scenario B**

**RBCA Equations:**

| CAS No.  | Chemical             | C <sub>source</sub><br>(mg/L) | R26            | IEPA GWcomp (mg/L)          |                 |
|----------|----------------------|-------------------------------|----------------|-----------------------------|-----------------|
|          |                      |                               | C(x)<br>(mg/L) | Obtained from SSL Worksheet |                 |
|          |                      |                               |                | Tier 1 Class I              | Tier 1 Class II |
| 156-59-2 | 1,2-Dichloroethylene | 0.074                         | 0.0042530      | 0.07                        | 0.2             |
| 75-01-4  | Vinyl chloride       | 0.035                         | 0.0020116      | 0.002                       | 0.01            |





Management Review  
Other

Technical Review  
Project Manager

Graphic Standards  
Lead Professional

QUALITY  
CONTROL

This document has been developed for a specific application and may not be used without the written approval of Montgomery Watson.

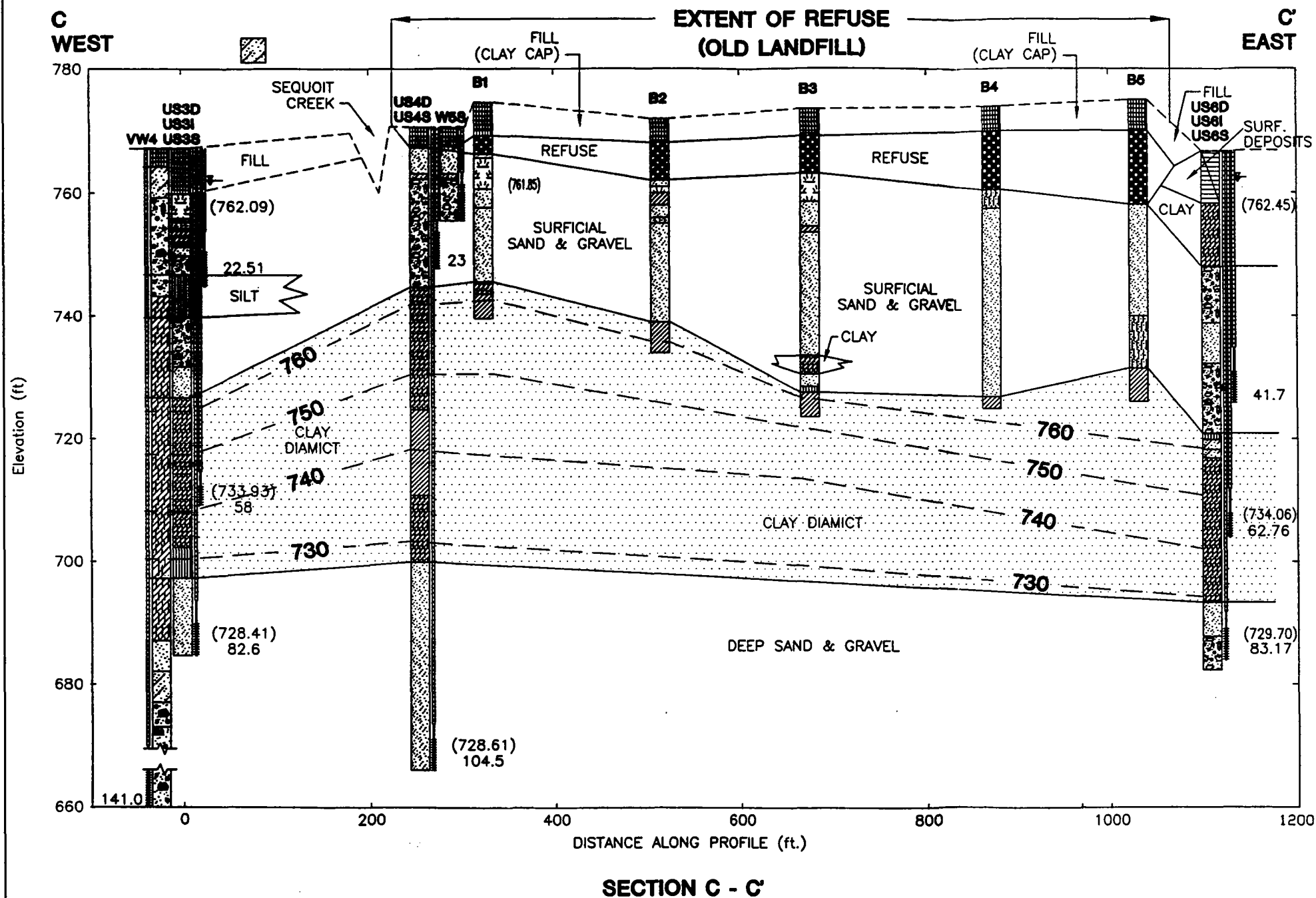


FIGURE 2

|              |   |
|--------------|---|
| Developed By | DKP                                       |
| Approved By  | SJC                                       |
| Date         | 4/16/98                                   |
| Reference    | J:/1252/035/03090210/MWDWGS/X-SECTION.dwg |
| Revisions    |   |

**GEOLOGIC CROSS-SECTION C-C'**

REMEDIAL INVESTIGATION  
H.O.D. LANDFILL  
WASTE MANAGEMENT OF ILLINOIS, INC.  
ANTIOCH, ILLINOIS

Drawing Number  
1252035

**MONTGOMERY  
WATSON**